CONTRIBUTIONS TO THE KNOWLEDGE OF THE FRENCH DESMID FLORA 2. RARE AND REMARKABLE TAXA FROM THE REGIONS OF SOLOGNE AND BRENNE

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ABSTRACT — The examination of 32 samples collected in 1983, 1990 and 1993 in the regions of Sologne and Brenne in central France revealed a number of new, rare or otherwise noteworthy desmid taxa. In the present paper 23 taxa, belonging to the genera *Closterium* (3), *Pleurotaenium* (3), *Euastrum* (1), *Cosmarium* (13), *Staurodesmus* (1) and *Staurastrum* (2) are depicted and discussed. Three taxa are newly described: *Cosmarium boitierense* sp. nov., *C. boitierense* var. *inambitiosum* var. nov. and *C. pseudowembarense* sp. nov.; four taxa are renamed and their taxonomic status is changed: *Cosmarium berryense* nom. et stat. nov., *C. jaoi* nom. et stat. nov., *C. lutetianum* nom. et stat. nov. and *Staurodesmus reginae* nom. et stat. nov. In addition, the name of a taxon only known from North America is recombined: *Cosmarium dilatatum* var. *concavum* comb. nov.

RÉSUMÉ — L'examen de la flore desmidiale de 32 récoltes, prélevées en 1983, 1990 et 1993 dans la Sologne et la Brenne, au centre de la France, a permis de mettre en évidence un certain nombre de taxons nouveaux, rares ou autrement remarquables. Dans ce travail, 23 taxons, appartenant aux genres *Closterium* (3), *Pleurotaenium* (3), *Euastrum* (1), *Cosmarium* (13), *Staurodesmus* (1) et *Staurastrum* (2) sont identifiés et discutés. Trois taxons sont décrits comme nouveaux: *Cosmarium boitierense* sp. nov., *C. boitierense* var. *inambitiosum* var. nov. et *C. pseudowembarense* sp. nov.; quatre taxons reçoivent un nouveau nom et voient leur statut taxinomique modifié: *Cosmarium berryense* nom. et stat. nov., *C. jaoi* nom. et stat. nov., *C. lutetianum* nom. et stat. nov. et *Staurodesmus reginae* nom. et stat. nov. En outre, le nom d'un taxon connu seulement d'Amérique du Nord fait l'objet d'une nouvelle combinaison: *Cosmarium dilatatum* var. *concavum* comb. nov.

KEY WORDS: Brenne, desmids, France, freshwater green algae, Sologne, taxonomy.

INTRODUCTION

The regions of Sologne and Brenne are situated in the heart of France. Sologne is bordered on the north by the river Loire and on the south by the river Cher, covering part of the "départements" Loiret, Loir-et-Cher and Cher. Brenne lies south of Sologne, in the

"département" Indre. It forms the south-west of the old province of Berry, and is bordered on the north by the river Indre, stretching southward to the river Creuse and somewhat beyond. The major part of Brenne is designated a regional park in 1989.

Both the regions of Sologne and Brenne contain hundreds of smaller and larger ponds and lakes (French: "étangs"). Most of the lakes are artificial: they were created for fish-farming by monks in the middle ages. Situated on tertiairy sands and loam, the lakes in both regions have much in common, chemically as well as phycologically. However, few papers have been published on the algal flora, and more specifically on the desmids of these lakes (Allorge & Lefèvre, 1931; Lefèvre & Arlet, 1943; Lefèvre & Wurtz-Arlet, 1948; Wurtz, 1947, 1948).

In 1983, 1990 and 1993, as part of my studies into the desmid flora of France, I had the opportunity to collect a total of 32 samples on 29 different localities scattered over Sologne and Brenne. Although many lakes were eutrophied, desiccated or otherwise had become unfit for the development of a rich desmid flora, a total of 220 desmid taxa were recorded. In the present paper 23 remarkable taxa, occurring in one or more samples originating from 23 different localities (8 in Sologne and 15 in Brenne) are depicted and discussed taxonomically.

MATERIALS AND METHODS

The samples originate from different sites and habitats and details are given in Tables 1 and 2. The algal material was collected by squeezing out the dominant aquatics and mosses. Shortly after sampling it was fixed with formaldehyde to a final concentration of about 4%. Material was studied light microscopically, and drawings were made with the aid of a drawing tube. New reports for France are marked with an asterisk (*) in front of the species name.

OBSERVATIONS

Closterium exiguum W. & G.S. West
(Figs 3, 4)

This rare and poorly known desmid was encountered in small numbers in samples from two localities: Étang du Briou (S5) and Étang de l'Épineau (B15).

The cells are regularly and rather strongly curved, with very narrow apices without (visible) end-pore. Cell dimensions are: length 70-84 µm, breadth 4.4-4.6 µm.

Our material agrees rather well with the original description of this taxon by W. & G.S. West (1902) from paddy-fields on Ceylon. However, the taxonomy of *C. exiguum* is unclear. It resembles *C. acutum* Brébisson *in* Ralfs var. *variabile* (Lemmermann) W. Krieger, which on an average is longer and comparatively narrower. In addition, last mentioned taxon is generally irregularly curved to sigmoid. Krieger (1935) regards *C. exiguum* synonymous with *C. parvulum* Nägeli var. *angustum* W. & G.S. West which, according to Ruzicka (1977), in turn might not be related to *C. parvulum*. *C. parvulum* var.

angustum was also encountered in the study area (see below). It co-occurred with *C. exiguum* in Étang de l'Épineau, but was clearly distinguishable.

C. exiguum has previously been reported from France by Laporte (1931), from the oligo-mesotrophic Lac de Cazaux-Sanguinet-Biscarosse (Dépt Landes), unfortunately without a figure. The few remaining records of *C. exiguum* available denote it as an acidophilous taxon, which is in striking contradiction with the present finds. However, the identification of *C. exiguum* in these papers is subject to doubt (e.g., Grönblad, 1934; Tomaszewicz, 1973, 1988) and more finds are needed.

Closterium parvulum Nägeli var. ***angustum*** W. & G.S. West
(Fig. 2)

Cells attributed to this uncommon taxon were encountered in small numbers in samples from Étang de Grandelle (B6), Étang Alcoa (B7), a pool near Rosnay (B10) and Étang de l'Épineau (B15).

The cells are rather strongly curved and gradually tapering towards the narrowly rounded apices which are provided with a small end-pore. Cell dimensions are: length 106-110 µm, breadth 7.0-7.7 µm.

The present material agrees well with the description in Ruzicka (1977). In the original description of this taxon from England by W. & G.S. West (1900) no mention is made of the presence of an end-pore; however, later authors indicate a small but distinct pore in the narrowly rounded apex (compare, e.g., Förster, 1982). Ruzicka (1977) doubts whether this variety should be atributed to *C. parvulum*. In my opinion, the general cell shape suggests a relation with *C. parvulum*; var. *angustum* should otherwise be made a separate species. However, more detailed information on the shape of the apex is needed before a decision can be made. According to Krieger (1935) *C. parvulum* var. *angustum* would be synonymous with *C. exiguum* (see above).

This meso- eutrophic taxon was previously mentioned from Étang de Kergadoret (Dépt Morbihan) by Compère (1969), unfortunately without an accompanying figure, and from Étang Rablais (Dépt Sarthe) by Manguin (1936), with a figure very similar to the present material (see also below under *Euastrum germanicum* and *Cosmarium berryense*).

Closterium parvulum Nägeli var. ***cornutum*** (Playfair) W. Krieger
(Fig. 1)

A few specimens of this rare taxon were encountered in a sample from Étang de l'Hardouïne (B14).

The cells are strongly curved, rather broad but not swollen in the middle, and strongly tapering towards the narrowly rounded apices; the apex is provided with a small end-pore. Cell dimensions are: length 115-120 µm, breadth 20-22 µm.

These dimensions are somewhat below the lower limit given for this taxon by Ruzicka (1977; compare also Dürrschmidt, 1985). The shape of the apex and the absence of a central inflation point to a relation with *C. parvulum*.

This taxon was originally described from Australia (N.S. Wales; see Playfair, 1907), but apparently it has a world-wide distribution. However, most finds need confirmation and its ecological preferences are as yet unknown.

* ***Pleurotaenium excelsum*** (Turner) Gutwinski var. ***borgei*** (W. & G.S. West) Bando (Figs 9, 10)

Cells of a *Pleurotaenium* species were found in small numbers in a sample from Étang des Levrys (S8).

The cells are rod-like and comparatively narrow, faintly attenuating towards the very slightly inflated apex. The semicells have a distinct basal inflation and one or two smaller undulations above it. At lower magnifications, the apex appears smooth. However, at higher magnifications generally an apical or slightly subapical ring of small tubercles is visible, with up to six visible simultaneously. In some semicells these tubercles are only poorly developed and hardly discernible. Chloroplasts are most probably ribbon-like, containing numerous small pyrenoids. Some ten crystals are visible in the apical vacuole. Cell dimensions are: length 340-352 µm, breadth (at the level of the basal inflation of the semicells) 18-18.5 µm, length/breadth ratio *ca* 19.

This *Pleurotaenium* was first identified as *P. baculoides* (Roy & Bisset) Playfair. However, this last-mentioned taxon is characterized by longer and comparatively narrower cells, measuring up to 685 × 23 µm, without any apical ornamentation (Ruzicka, 1977). *P. baculoides* was originally described from Japan by Roy & Bisset (1886). Unfortunately they figure only one semicell at low magnification, measuring 265 × 15 µm (Roy & Bisset, *loc. cit.*, pl. 268: 18). *P. baculoides* was recently reported from South-West France, by Capdevielle (1979). His figure shows a cell that is similar to the forms given by Ruzicka (1977), but clearly different from the present material (Capdevielle, *loc. cit.*, pl. 8: 2). On the other hand, cells identical with the *Pleurotaenium* under discussion have been reported as *P. baculoides* by Kouwets (1987) from Lac de Bourdouze in the French Auvergne, ■ habitat rather similar to that of the present material.

The present material also resembles *P. ehrenbergii* (Ralfs) De Bary. However, the apex of *P. ehrenbergii* is never inflated and the crown of tubercules is different and never placed subapically (Ruzicka, 1977). In addition, the present cells are rather slender as compared with those attributed to the nominal variety of *P. ehrenbergii*, and too short as compared with its var. *elongatum* (W. West) W. West (Ruzicka, 1977; see also below).

In 1988, Bando published an extensive revision of *Docidium*, *Haplotaenium* and *Pleurotaenium* in which he presents three varieties of *Pleurotaenium excelsum* (Turner) Gutwinski, viz., the nominal variety, var. *borgei* (W. & G.S. West) Bando and var. *angustum* (W. & G.S. West) Bando. These varieties are characterized by elongate semicells with a prominent basal inflation and one or a few swellings above it. The semicells are slightly tapering towards the truncately rounded apex, on which 3-6 small conical tubercles are visible. The varieties are mainly differing in their cell diameter. The nominal variety, measuring 400-520 µm × 21-24 µm, is considered synonymous with *P. ehrenbergii* (Ralfs) De Bary var. *elongatum* (W. West) W. West by Bando (1988), but in my opinion these taxa in their original conception are morphologically different and should be kept separate. Var. *borgei* was originally described as a variety of *P. ehrenbergii* from Ceylon by W. & G.S. West (1902). The original drawing given by these authors (*loc. cit.*, pl. 18: 28) agrees rather well with the drawings given by Bando (1988, fig. 18: 4-7), and also with the present material. As dimensions W. & G.S. West (1902) give 368 × 19 µm, and Bando (1988) gives 280-455 µm × 16-21 µm, with a length/breadth ratio of 16.5-23.4. Even more interesting are micrographs of Bando (1988, fig. 42: 3, 4) which show cells with slightly inflated apices. The present material is therefore identified as *P. excelsum* var. *borgei*. Var. *angustum*, most curiously also described by W. & G.S. West in their same 1902 Ceylon paper, but as a variety of their *P. hypocymatium*, apparently is only a more slender form of var. *borgei*.

Ruzicka (1977) considered *P. excelsum* not indigenous in Europe. Disregarding the suggested synonymy with *P. ehrenbergii* var. *elongatum* (see above), its main area of distribution seems to be Asia, and the present find of var. *borgei* in France is the first European report. This taxon most probably is more common in similar mesotrophic habitats.

Pleurotaenium maximum (Reinsch) Lundell
(Fig. 8)

Pleurotaenium maximum was found in small numbers in a sample from Étang des Levrys (S8).

The cells are elongate and rod-shaped, only slightly attenuated towards the smooth, truncate apex. The semicells have a basal inflation, and one or two more or less prominent undulations above it. The chloroplasts have numerous small and scattered pyrenoids. Cell dimensions are: length 850-900 µm, breadth (at the level of the basal inflation of the semicells) 50-52 µm.

P. maximum is often classified as *P. trabecula* (Ehrenberg) *ex* Nägeli var. *maximum* (Reinsch) Roll (e.g. Krieger, 1937; see Ruzicka, 1977). However, the overall morphology of *P. maximum* is different from that of *P. trabecula*, and more specifically from its large varieties *crassum* Wittrock and *robustum* Hustedt, by its more cylindrical semicells (Ruzicka, 1977). Most interestingly, *P. trabecula* var. *robustum* was also encountered in the study area, but in a different habitat (see below). A taxon very similar to *P. maximum* is *P. archeri* Delponte: both taxa are generally considered synonymous (Ruzicka, 1977; compare W. & G.S. West, 1902; see, however, Bando, 1988).

This large *Pleurotaenium* apparently is very rare. It has previously been reported from France by Lemaire (1884, 1889, as *P. archeri*), Des Cilleuls (1929, from the river Loire!), Pourriot *et al.* (1969, from Étang du Brochet, Dépt Yvelines), Tassigny (1975, from various localities, among which Étang du Puits and Étang de Pommereau in Sologne), and Capdevielle (1979), but unfortunately none of these authors provided a figure. Cells very similar to the present material were encountered in a sample from the mesotrophic Étang de Balcère, in the eastern French Pyrénées (Kouwets, unpublished).

Pleurotaenium trabecula (Ehrenberg) *ex* Nägeli var. ***robustum*** Hustedt
(Figs 11, 12)

Very broad specimens of *P. trabecula* var. *robustum* were encontered in small numbers in a sample from Étang de l'Épineau (B15).

The cells are rod-shaped; the semicells have a prominent basal swelling, occasionally followed by a faint undulation directly above it. They are gradually tapering towards the smooth, truncate apex. In a few specimens the lower half of the semicells (apart from the basal swelling) is almost cylindrical. Cell dimensions are: length 460-600 µm, breadth (at the level of the basal swelling of the semicells) 63-73 µm, breadth of apex 25-30 µm.

The poorly known *P. trabecula* var. *robustum* was described by Hustedt (1911), from a ditch in the Austrian Alps (Tirol), but unfortunately without a figure. Cell dimensions were given as 362.5 × 62.5 µm. Dick (1926) was the first who published a figure of a *Pleurotaenium* attributed to this variety, and his material originated from a boggy habitat in Germany. The present forms, on the other hand, occurred in a sample

from a eutrophic, slightly alkaline lake. The figure given by Dick (*loc. cit.*, pl. 18: 5) is rather similar to the material figured in the present paper, but its dimensions only measure *ca* 320 × 52 µm.

This taxon has previously been mentioned from France by Deflandre (1929) and Laporte (1931), from bogs in the Haute-Savoie. Unfortunately, Deflandre (*loc. cit.*) didn't present a figure; the figure given by Laporte (*loc. cit.*) shows a slightly inflated semicell. Wurtz (1947) mentions *P. trabecula* var. *crassum* Wittrock from Étang Massé in Brenne, measuring 400 × 55 µm. However, according to Ruzicka (1977) var. *crassum* is generally smaller than 50 µm. In addition, the figure given by Wurtz (*loc. cit.*, fig. 19) is very similar to the present material.

Euastrum germanicum (Schmidle) W. Krieger
(Figs 5-7)

This *Euastrum* species was found as a rare element in samples from three lakes in Brenne, viz., Étang du Grand Mez (B5), Étang Alcoa (B7), and Étang de l'Épineau (B15).

The cells are circular to slightly oval in outline; the apical lobe of the semicells is rather narrow with parallel sides or only slightly dilated; the basal and lateral lobes are slightly conical and obtusely rounded. Incisions between basal and lateral lobes are right — to acute-angled; those between lateral lobes and apical lobe are similar but slightly deeper. The lobes are ornamented with rows of small conical warts which may be geminate or divided into two to four smaller granules. The centre of the semicells has an ornamentation of larger, obtuse and sometimes divided warts, generally roughly arranged in concentric circles (Figs 6, 7). In some specimens a tendency to a more linear arrangement of the inner warts of this central ornamentation is visible (Fig. 5). Cell dimensions are: length 54-60 µm, breadth 50-54 µm, thickness 28 µm.

The taxonomy of *E. germanicum* and the related species *E. spinulosum* Delponte and *E. gemmatum* (Brébisson) Brébisson *ex* Ralfs is very confused (Krieger, 1937; Coesel, 1978; Ruzicka, 1981). However, I disagree with the opinion advanced by last-mentioned author. I subscribe the opinion of Grönblad (1960), who pointed out that *E. gemmatum* is a clearly defined species not closely related to either *E. germanicum* or *E. spinulosum*. On the other hand, *E. germanicum* and *E. spinulosum* obviously are very closely related; *E. spinulosum* and its infraspecific taxa apparently have a more (sub)tropical distribution (Krieger, 1937). The many intermediate cell forms reported in literature suggest that *E. germanicum* may be regarded as a "temperate" variety of *E. spinulosum*. However, for mere practical reasons both taxa will be treated as separate species here, and the present material is referred to *E. germanicum*. The taxon originally described as *E. gemmatum* ssp. *mononcylum* by Nordstedt (1880) in consequence should better be classified as *E. spinulosum* var. *mononcylum* (Nordstedt) Gutwinski. Classification of the most interesting forms of var. *mononcylum* with two additional, weakly developed lateral humps (see, e.g., Förster, 1969) requires a closer study after new finds of rich material. The disposition of the central warts in the material from Étang de l'Épineau was similar to that in *E. germanicum* var. *bulnheimii* (Raciborski) W. Krieger (see Fig. 5). However, this character seems too trivial to justify classification as a separate variety (compare Ruzicka, 1981).

A *Euastrum* very similar to the present material has been reported under *E. spinulosum* from Lac de Grand-Lieu (Dépt Loire Atlantique) by Allorge (1924; see, however, Grönblad, 1931, who referred this form to *E. mononcylum* var. *germanicum*). Allorge & Lefèvre (1931) mentioned *E. spinulosum* from Étang de Fontenille in Sologne, unfortuna-

tely without a figure. Manguin (1936) reported this taxon with figures similar to the present material from Étang des Rablais (Dépt Sarthe). Wurtz (1947) described *E. spinulosum* (Schmidle) Krieger (*sic*!) var. *gallicum* from Étang Grand Riau in Brenne. In last-mentioned variety the granules on the lateral lobes occur up to the central ornamentation. The taxonomic value of this character, however, is questionable (compare Ruzicka, 1981). Messikommer (1957) reported *E. spinulosum* from a lake near St. André-de-Bouchoux ("les Dombes", Dépt Ain). His figure (Messikommer, *loc. cit.*, pl. 1: 2) shows a cell with clearly dilated apical lobes and rather narrow and acute angles between apical lobe and upper lateral lobes, characters indeed considered discriminative of *E. spinulosum* by Grönblad (1921).

Cosmarium angulosum Brébisson var. ***concinnum*** (Rabenhorst) W. & G.S. West
(Figs 29-40)

In samples from nearly all sites in Sologne (S5 and S8 excepted) and from sites B1-3 and 8-11 in Brenne, specimens of a small and morphologically variable *Cosmarium* were found in rather small numbers.

The semicells are more or less hexagonal; the apex is generally rather narrow but sometimes broader, straight or convex and merging into the lateral angles. The sides are straight or slightly retuse and sometimes diverging; the sinus is linear and closed. The semicells are oval in apical view, and broadly and truncately oval in lateral view. Cell dimensions are: length 15-18 µm, breadth 12-14 µm, thickness 7-8 µm.

The taxonomy of smooth-walled smaller *Cosmarium* taxa is very confused, and it is with some reserve that I attribute the present material to *C. angulosum* var. *concinnum*. However, general outline and morphological variability agree rather well with the figures of this taxon given by Grönblad (1924, pl. 2: 31-35). These figures are drawn after the original material collected by Rabenhorst (see also Kouwets, 1997). In addition, the dimensions of the present material are nearly the same as those mentioned by Grönblad (1924).

C. angulosum var. *concinnum* has previously been reported from France by several authors. However, only Manguin (1934, 1937) and Baïer *et al.* (1984) give figures, clearly representing very different taxa. Due to the taxonomical confusion, the ecology of *C. angulosum* var. *concinnum* is poorly known.

* ***Cosmarium asymmetricum*** Rich
(Figs 41-44)

Samples from nine localities (S2, 3, 5 and B3, 4, 9, 10, 12, 15) contained cells of a small but remarkable *Cosmarium*.

The cells are characterized by their asymmetrical front view: one side of the cells appears compressed. The shape of the semicells is very variable. The basal angles are rounded, the sides are concave and straight (one side) or diverging (other side), the apical angles are broadly rounded and sometimes merging into the lateral angles and the apex is more or less truncate or flattened with a central dent or notch. The semicells are subcircular in side view and broadly elliptic in apical view with a small central papilla. Cell dimensions are: (maximum) length 11-13 µm, breadth 9-11 µm, thickness 6.5 µm.

The present material is identical with specimens described from South Rhodesia (now Zimbabwe) as *C. asymmetricum* (Rich, 1935). Reports on similar, asymmetrical *Cosmarium*'s are very scarce, and only known from Africa. Slightly larger cells of *C. asymmetri-*

cum are reported by Rino (1972) from Mozambique. A second, larger asymmetrical species was described from West-Africa by Brandham (1967) as *C. dolabriforme*; slightly aberrant cell forms of this taxon are mentioned by Gauthier-Lièvre (1958) and Williamson (1994) under *C. asymmetricum*.

The present find in central France is the first report of a *Cosmarium* with an asymmetrical front view outside the tropics (*C. obliquum* Nordstedt, a species from upland and arctic-alpine areas, is asymmetrical in the apical view). It would be very interesting to know whether the occurrence of *C. asymmetricum* in Sologne and Brenne is just an accident (due to transport by waterfowl?), or whether the species is more common in similar eutrophic habitats in Western Europe.

Cosmarium berryense nom. et stat. nov.
Replaced synonym: *Xanthidium robinsonianum* Archer var. *divergens* Grönblad, 1938, *Bot. Not.* 1938, p. 52, fig. 8 (original description and figure)
(Figs 22, 23)

A small but characteristic *Cosmarium* was found in rather small numbers in samples from 12 different localities, including one in Sologne (Étang de la Boitière, S2) and most of the localities sampled in Brenne (B1, 3-10, 14, 15).

The cells are slightly longer than broad with a closed sinus. The semicells are hexagonal in outline, witht the lower part of the sides diverging and crenate, the lateral angles slightly protruding and bicrenate, and the upper part of the sides strongly concave. The apex is straight and 4-undulate, including the crenate apical angles. Crenations have short rows of small granules, and the apex has four intramarginal granules. The centre of the semicells is provided with two horizontally arranged small granules. The semicells are broadly oval in apical view and only faintly tumid at the level of the central papillae; they are subcircular in side view. Cell dimensions are: length 20-22 µm, breadth 18-21 µm, thickness 10-11 µm.

Searching the literature, a number of figures were found of specimens that are very similar to the present material. Most of these cell forms are attributed to *C. humile* (Gay) Nordstedt. Manguin (1936) reported a "*C. humile*, forma?" from the calcareous Étang des Rablais (Dépt Sarthe; see also above under *Euastrum germanicum*). His figures differ from the present material only in the presence of one central wart on the semicells instead of two small granules (Manguin, *loc. cit.*, pl. 4: 57-58). Huzel (1936, pl. 11: 6-8) reported a rather similar form as *C. humile* var. *subdanicum* Schmidle forma, from mesotrophic habitats in South-West Germany. Grönblad (1938) described *Xanthidium robinsonianum* var. *divergens* from South-East Finnland. His figure shows front and apical views of a semicell that are very similar to the present material, with a central ornamentation of three small granules (Grönblad, *loc. cit.*, figs. 8a-b). Finally, in 1960 Grönblad figured a *C. humile* forma from rather eutrophic habitats in Italy. The central wart in his material apparently is divided into four small granules (Grönblad, *loc. cit.*, pl. 6: 130-131; pl. 13: 6 [micrograph]). In addition, Grönblad (*loc. cit.*) figured ■ *C. garrolense* that is very similar to the material described in the present paper under *C. jaoi* (see below).

General cell shape and ornamentation suggest that the form under discussion is not closely related to *C. humile* or one of its varieties (compare Schmidle, 1896), nor to *Xanthidium robinsonianum* (compare, e.g., W. & G.S. West, 1912), and it should therefore be classified as a separate species. However, raising the variety described by Grönblad (1938) in rank and transferring it to the genus *Cosmarium* would lead to a later homonym of *C. divergens* W. Krieger. Therefore it is proposed to give the present form the new name *C. berryense*, after the old name of the region "Berry" (see the introduction of this paper).

This species obviously is widely distributed but very rare, preferring meso-eutrophic habitats.

Cosmarium boitierense sp. nov.
(Figs 53-55)
Cosmarium boitierense var. **inambitiosum** var. nov.
(Figs 56-62)

In samples from all but 7 of the localities mentioned in the present paper, cells of two very similar small *Cosmarium*'s were found in varying numbers. The two forms obviously are closely related and mainly differed by their cell dimensions. Each of the two *Cosmarium* forms was found on 9 localities: the larger cell form (see Figs 53-55) on S1-3, S5, B3, B4, and B8-10, and the smaller cell form (see Figs 56-62) on S2, S6-7, B3, B6-7, B12-13 and B15. On two localities (S2 and B3) both forms co-ocurred. The following diagnosis applies to both forms:

The cells are slightly longer than broad, moderately constricted, with a closed sinus. The semicells are basically hexagonal but with a very variable outline. The basal angles are obtuse to broadly rounded, the lower parts of the sides are straight or weakly concave and diverging, and the upper parts generally concave and converging towards a broadly truncate apex or, occasionally, merging into a convex apex. The apex has a central dent which is frequently flanked on either side by an additional undulation. In apical view the cells are elliptic with broadly rounded angles, the larger cells with a small papilla, the smaller cells with a more or less prominent central protuberance at the centre of each side of the semicells. The semicells are (sub)circular in side view. Cell dimensions of the larger specimens are: length 14-17 µm, breadth 13-15 µm, thickness *ca* 8 µm, and of the smaller specimens: length 11-14 µm, breadth 10-11.5 µm, thickness 6-8 µm.

The larger *Cosmarium* specimens agree rather well with a taxon reported under *C. subtransiens* Croasdale forma by Coesel (1991). However, Coesel (*loc. cit.*) questioned the identification of his material and suggested that it might rather be described as a new species. Similar cells are also given under *C. quadratulum* (Gay) De Toni (see, e.g., Insam & Krieger, 1936, pl. 3: 13). However, the concept of *C. quadratulum* and its infraspecific taxa is very confused (compare Coesel, 1984).

Therefore, the two *Cosmarium* forms under discussion should better be described as new taxa:

The larger specimens:
Cosmarium boitierense Kouwets var. ***boitierense***
Diagnosis: *Cellulae parvae, longitudine latitudinem paulum superante, sinu profunde et clauso. Semicellulae hexagonales, partibus inferioribus marginum lateralium divergentibus, partibus superioribus convergentibus; ambae partes rectae aut concavae. Apex leviter convexus, in media parte retusus lateribus saepe undulatis. Semicellulae a vertice visae ellipticae angulis valde rotundatis, papilla mediana parva instructae; a latere visae (sub)circulares.*
Dimensiones: longitudo 14-17 µm, latitudo 13-15 µm, crassitudo 6-8 µm.
Holotypus: figura nostra 53

The smaller specimens:
Cosmarium boitierense var. ***inambitiosum*** Kouwets
Diagnosis: *Varietas dimensionibus minoribus atque tuberculis medianis distinctis a varietate nominata differt.*

Dimensiones: longitudo 11-14 µm, latitudo 10-11.5 µm, crassitudo 6-8 µm.
Holotypus: figura nostra 56

The species is named after one of the localities where both varieties occurred together: Étang de la Boitière (S2); the varietal name *inambitiosum* means modest. Both taxa most probably have a much wider distribution in meso — eutrophic habitats.

* ***Cosmarium dilatatum*** Lütkemüller *in* Järnefeld & Grönblad
(Figs 26, 27)

Characteristic cells of *C. dilatatum* were found in rather small numbers in a sample from Étang de Paris (S1).

The morphology of the cells agrees very well with that of the material recently reported from The Netherlands by Coesel (1989), including the doubled central protrusion. The semicells are (sub)rectangular to inverted trapezoid, with extracted apical angles provided with a conical spinule. The apex is generally convex with a central excavation flanked by two intramarginal granules. A variable ornamentation of small granules is present near the basal and apical angles. Cell dimensions are: length 8.5-9 µm, breadth 8.5-11 µm, thickness 5-5.5 µm.

A *Cosmarium* obviously related to *C. dilatatum* was described by Sieminska (1965) from a pool in Montana, U.S.A., as *C. cymatonotophorum* var. *concavum*. However, cell morphology clearly suggests that this variety is not related to *C. cymatonotophorum* (compare, e.g., Kouwets, 1991), and should better be transferred to *C. dilatatum*:

C. dilatatum var. ***concavum*** (Sieminska) Kouwets comb. nov.
Basionym: *C. cymatonotophorum* W. West var. *concavum* Sieminska, 1965, *Trans. Amer. Microsc. Soc.* 84, p. 109, pl. 3: 21-25.

The nominal variety of *C. dilatatum* is not known from North America (Prescott *et al.*, 1981). As already remarked by Coesel (1989), *C. dilatatum* forms a morphological link between smaller *Cosmarium* and *Euastrum* species (compare, e.g., *E. ornans* Förster, in Förster, 1969). *C. dilatatum* apparently prefers larger, meso - eutrophic water-bodies; it most probably has a much wider distribution than presently known.

Cosmarium haynaldii Schaarschmidt
Synonym: *Cosmarium decachondrum* Roy & Bisset
(Fig. 16)

A few cells of this very rare species were found in a sample from Étang de Grandeffe (B6).

In front view the cells are more or less truncate circular with an undulating outline. Within the apical margin a row of 6 conical warts is visible; additional warts are generally present near the basal angle. I side view the semicells are circular with a flattened apex. The apical view is elliptic, showing three vertical ridges at the centre, which are not visible in front view, and two prominent conical warts at the basal angle. Dimensions of the depicted specimen are: length 30 µm, breadth 30 µm, breadth of isthmus 9 µm, thickness 17 µm.

The present material in the first instance was determined as *C. decachondrum*. This species was originally described from Japan by Roy & Bisset (1886). It has been reported from South-West France by Capdevielle (1982), and has also been found in The Netherlands (Coesel, 1991). However, Schaarschmidt (1883) had described *C. haynaldii* from Hungary, which species apparently is identical with *C. decachondrum*. Consequently the epithet *haynaldii* has priority. Raciborski (1889) classified both *C. decachondrum* and *C. haynaldii* as varieties under *C. taxichondrum* Lundell, together with two other taxa (compare also Grönblad, 1962; Grönblad & Croasdale, 1971).

In my opinion, the form under discussion shows only a superficial morphological resemblance to *C. taxichondrum* and should better be classified as a separate species: *C. haynaldii*. The many, mostly tropical varieties attributed to *C. taxichondrum* need re-evaluation. *C. haynaldii* apparently has a wide but scattered distribution in more or less mesotrophic habitats.

Cosmarium jaoi nom. et stat. nov.
Synonym: *Cosmarium garrolense* Roy & Bisset var. *crassum* Jao, 1949, *Bot. Bull. Acad. Sinica* 3, p. 51, pl. 1: 38 (original description and figure)
(Figs 13-15)

A *Cosmarium*, in the first instance identified as *C. garrolense* var. *crassum*, was found in small numbers in samples from Étang du Grand Mez (B5), Étang de la Cure (B9) and a pool near Rosnay (B10).

The cells are broadly oval in outline; the cell wall is weakly undulating with 5 undulations between basal and apical angle; the apex is truncate, the sinus is closed. Side and apical views of the semicells are broadly oval. Some cells show the presence of a row of faint intramarginal granules along the sides. Cell dimensions are: length 42-47 µm, breadth 32-36 µm, thickness *ca* 21 µm.

The present specimens agree well with the original description of *C. garrolense* var. *crassum* from China by Jao (1949). This taxon has also been reported from France by Capdevielle (1985) and from The Netherlands by Coesel (1979). From Italy, Grönblad (1960) mentioned *C. garrolense*, unfortunately without additional information. Yet, his figure (micrograph) shows a cell that is very similar to the present material (Grönblad, *loc. cit.*, pl. 13: 4). See also the remarks under *C. berryense*.

However, in my opinion general cell morphology suggests that var. *crassum* is not related to *C. garrolense*, and it should better be raised in rank to that of a separate species. To avoid any possible confusion with *Cosmarium crassum* Brébisson *in* Meneghini [publication invalid according to ICBN Art. 13.1; = *Euastrum crassum* (Brébisson) Kützing *ex* Ralfs], it is proposed to name the new species after its original author Chin-Chih Jao: *Cosmarium jaoi* Kouwets.

C. jaoi apparently is a very rare but widely distributed species from meso-eutrophic habitats.

Cosmarium limnophilum Schmidle
Synonym: *Cosmarium boeckii* Wille var. *isthmolaeve* Skuja *ex* Kouwets, 1991, p. 392, pl. 5: 1-2
(Figs 17, 18)

A few cells of a *Cosmarium* identified as *C. boeckii* var. *isthmolaeve* were found in a sample from Étang du Grand Mez (B5). The original invalid publication of this combina-

tion by Skuja (1976) was validated by Kouwets (1991). However, *C. boeckii* var. *isthmolaeve* apparently is synonymous with *C. limnophilum*, described by Schmidle (1896).

The semicells are trapeziform with convex sides and a straight apex. The sides including basal and apical angles are 6-undulate, the apex is 4-undulate. The cell wall is ornamented with one or two rows of faint intramarginal granules. The characteristic central ornamentation with three granules (one facing the apex, two facing the isthmus) generally is only very weakly developed and not visible in front view (compare Schmidle, 1896; Skuja, 1976). In apical view the semicells are broadly elliptic with a faint indication of the ornamentation; in side view they are circular. Cell dimensions are: length 32-36 µm, breadth 27.5-31.5 µm, thickness *ca* 18 µm.

The present material agrees very well with the material reported from South-West France by Kouwets (1991). Laporte (1931) mentioned it from a bog in the Haute-Savoie (together with *Pleurotaenium trabecula* var. *robustum*, see above), but his figures show specimens with a rather aberrant cell shape. *C. limnophilum* was also reported from The Netherlands by Coesel (1991). *C. gibberulum* var. *subdistichum*, described by Grönblad (1926) probably is also synonymous with *C. limnophilum* (see also Messikommer, 1929; Laporte, 1931).

C. limnophilum apparently is a rare but widely distributed species from meso- to slightly eutrophic habitats.

▪ ***Cosmarium lutetianum*** nom. et stat. nov.
Replaced synonym: *Cosmarium pygmaeum* Archer var. *apertum* Skuja, 1956, *Nova Acta Reg. Soc. Scient. Upsal.*, Ser. IV, 16 (3), p.213, pl. 36: 16 (original description and figures)
(Figs 24, 25)

Cells of a very small *Cosmarium* were found in small numbers in samples from two localities: Étang de Paris (S1) and a lake near Mézières-en-Brenne (B4).

The semicells are trapeziform with irregularly rounded angles which are provided with a granule. The sinus is widely dilated. In apical view the semicells are elliptic, showing two granules near each angle; in side view they are trapeziform with a truncate apex flanked by two granules. Cell dimensions are: length *ca* 7 µm, breadth 6-7 µm, thickness *ca* 3.5 µm.

This taxon was originally described from Sweden by Skuja (1956) as *C. pygmaeum* var. *apertum*. The apical view induced Förster (1981) to transfer this variety to *C. sphagnicolum* W. & G.S. West. However, in my opinion the general cell morphology suggests that the taxon under discussion should better be raised in rank to that of a separate species. To avoid creation of a later homonym of *C. apertum* Turner, a new name must be chosen, and it is proposed to name it after the first locality mentioned above (Lutetia is the old latin name of Paris).

C. lutetianum apparently is a very rare (or easily overlooked?) species from meso - eutrophic habitats: after the publication of Skuja (1956) it had never been reported again.

Cosmarium pseudowembarense sp. nov.
(Figs 45-52)

Cells of a characteristic but unknown *Cosmarium* species were found more or less abundant in samples from four localities in Brenne: a lake near Mézières-en-Brenne (B4), Étang Montiacre (B13), Étang de l'Hardouïne (B14) and Étang de l'Épineau (B15).

Cell morphology is very variable. The cells are about as long as broad or a little longer, deeply constricted, with a closed sinus. The semicells are hexagonal in outline, with the basal angles obtuse to broadly rounded. The lower part of the sides is parallel or divergent and slightly concave, straight or broadly convex. The lateral angles are truncate to broadly rounded, the upper part of the sides is strongly convergent and straight to strongly concave. The apical angles are obliquely rounded-truncate merging into the notched apex. In apical view the semicells are oval with broadly rounded angles and a more or less prominent central swelling; in side view they are subcircular. Cell dimensions are: length 12-15 µm, breadth 10-15 µm, thickness 6-8 µm, length/breadth ratio 1.04-1.17.

The prominence of the central swelling obviously depends on the shape of the semicell: characteristic semicells with the upper part of the sides concave have a conspicuous bulge on either side whereas semicells with the upper part of the sides straight to convex are more or less oval in apical view (compare Fig. 49).

In view of the very similar cell morphology the present form is considered identical with the specimens given under *C. laeve* var. *pseudooctangulare* Fritch & Rich by Coesel (1979), collected in rather similar eutrophic habitats. Cells attributed to last-mentioned taxon were recently also reported from South-West France by Kouwets (1991). They differ from the material under discussion and that in Coesel (1979) in the upper part of the sides being straight to convex instead of concave. However, classification as a variety of *C. laeve* Rabenhorst is questionable. *C. laeve* is characterized by an elliptic apical view whereas similar cell forms with a central swelling or protuberance are generally attributed to *C. wembarense* Schmidle (compare Förster, 1982). The present material differs from *C. wembarense* mainly by its lower length/breadth ratio (according to Förster, *loc. cit.*, *ca* 1.33 in *C. wembarense*), and it is proposed to describe it as a new species:

Cosmarium pseudowembarense Kouwets

Diagnosis: *Cellulae parvae, longitudine latitudinem fere aequante aut paulum superante, sinu lineari profunde constrictae. Semicellulae hexagonales angulis basalibus obtusis aut valde rotundatis, partibus inferioribus marginum lateralium paralellis aut divergentibus, obtusis aut levissime convexis, partibus superioribus valde convergentibus et concavis; angulis superioribus rotundatis, apice excavato. Semicellulae a vertice visae ovales medio utrimque tumides, a latere visae subcirculares.*
Dimensiones: longitudo 12-15 µm, latitudo 10-15 µm, crassitudo 6-8 µm, long./lat. ratio 1.04-1.17
Holotypus: figura nostra 50

C. pseudowembarense seems to prefer larger, rather eutrophic water-bodies. The cell forms described under *C. laeve* var. *pseudooctangulare* by Kouwets (1991) may be synonymous but more information on the morphological variability within large populations is needed before a conclusion can be drawn.

* ***Cosmarium sexnotatum*** Gutwinski var. ***bipunctatum*** (Woloszynska) Coesel
(Figs 19-21)

Cells attributed to this taxon were found in small numbers in samples from four localities in Brenne: Étang du Grand Mez (B5), Étang de la Cure (B9), and two sites near Rosnay (B10, 11).

The semicells are more or less reniform in outline. The sides, including basal and apical angles, are manifestly 4-undulate; the apex is straight and weakly 4-undulate. The ornamentation of the semicells is generally very weakly developed. Along the sides sometimes one or two rows of intramarginal granules are visible; just below the central undulations of the apex two slightly more prominent granules are present. The characteristic central ornamentation of three vertical ridges is not visible in front view. In apical view the semicells are broadly elliptic with a faint indication of the three ridges; in side view they are circular. Cell dimensions are: length 32-34 µm, breadth 28-29 µm, thickness *ca* 18 µm.

C. sexnotatum var. *bipunctatum* apparently is a widely distributed but rare taxon, and its ecological amplitude is poorly known. In The Netherlands it occurs in mesotrophic, slightly acid fen hollows (Coesel, 1989).

Cosmarium sp.
(Fig. 28)

This *Cosmarium* was encountered in very small numbers in a sample from a pool near Rosnay (B10).

The cells are about as long as broad, moderately constricted, with a closed sinus. The semicells are broadly pyramidate-trapeziform with rounded basal angles. The upper part of the sides is slightly retuse just under the apex; the apical angles are truncate and the apex is straight. At the basal angles and at the apical region the cell wall is ornamented with series of small granules; a row of four granules is present on either side of the isthmus. The centre of the semicells is smooth and finely punctate. The apical view is oval with a faint undulation at the centre of each side; the side view of the semicells is subcircular. The dimensions of the depicted specimen are: length 22 µm, breadth 20 µm, thickness 12 µm.

Despite extensive searching, no figures were found in the literature matching the present material. However, it does not seem appropriate to describe this *Cosmarium* as a new species here, since only very few specimes could be studied, especially as concerns the ornamentation of the cell wall. New reports of richer material are urgently needed.

Staurodesmus reginae nom. et stat. nov.
Replaced synonym: *Staurastrum dickiei* Ralfs var. *rhomboideum* W. & G.S. West fo. *minor* De Pouques, 1952, *Rev. Gen. Bot.* 59, p. 310, pl. 2: 24 (original description and figure; illegitimate name acc. to ICBN Art. 53.5: later homonym)
(Figs 63, 64)

Specimens of a *Staurodesmus* species were found in abundance in a pool northeast of Bélâbre (B8), and in fair numbers in a pool near Rosnay (B10).

The semicells are more or less rhomboid in outline with a broadly convex apex; the angles are broadly rounded and provided with a short spine; the spines are sometimes curved and strongly convergent. In apical view the semicells are triangular with slightly concave sides and tumid angles. The cell wall is furnished with a marked pore-pattern, consisting of pore-rings encircling the angles, an apical pore-ring with a central pore, three rows of pores running form the apical ring down the cell wall in between the angles, and groups of 3-4 pores at the base of the angles. Cell dimensions are: length 22-23 µm, breadth without spines 20-21 µm, length of the spines 1-3 µm.

In view of the very similar cell morphology, the present form is considered identical with the material from a pool in the "Forêt de Rambouillet" (Dépt Yvelines), attributed to *Staurastrum dickiei* var. *rhomboideum* fo. *minor* by Bourrelly (1953). This taxon was described shortly before by De Pouques (1952) from l'Étang de la Grange en Woëwre, in the "Forêt de la Reine" (Dépt Meurthe-et-Moselle and Dépt Meuse). However, several authors had previously described a "forma *minor*" of *Staurastrum (Staurodesmus) dickiei*. Huber-Pestalozzi (1928) described *Staurastrum dickiei* fo. *minor* which is not mentioned by Teiling (1967) since no figure was given. Manguin (1936) reported *Staurastrum dickiei* forma minor which is mentioned by Teiling (1967), but most probably "forma minor" is only intended as part of the description. Grönblad (1948) reported *Staurastrum dickiei* var. *rhomboideum* fo. *minor* as a figure without any diagnosis or other information; nevertheless it is mentioned by Teiling (1967). Teiling (*loc. cit.*) did not recombine the taxa mentioned above under *Staurodesmus* but included them, partly as "Formae minores" in the respective varieties of *Staurodesmus dickiei*. However, none of these taxa are identical with the present form.

Moreover, as already discussed by Bourrelly (1953), the characteristic pore-pattern renders a relation of the present material with *S. dickiei* questionable. However, as suggested by their different cell morphology, in my opinion it is also not related with other *Staurodesmus* taxa with similar pore-patterns (compare Bourrelly, 1953). Therefore, I propose to classify the form under discussion as a separate species. Since the original name was a later homonym, a new name must be chosen:*Staurodesmus reginae* Kouwets, after the name of the original sampling place (regina = queen). No further information on the ecology of this apparently rare taxon is available.

Staurastrum bloklandiae Coesel & Joosten
(Figs 66, 67)

Characteristic cells of *S. bloklandiae* were encountered in small numbers in samples from four localities: Étang de la Boitière (S2), Étang de Bièvre (S6), a pool near Rosnay (B12) and Étang de l'Hardouïne (B14)

This taxon was recently described by Coesel & Joosten (1996) after Dutch material. They also included data on the present material from the two localities in Sologne mentioned above. However, later on the taxon was also found on two localities in Brenne. This material agreed very well with the original description although some specimens were slightly smaller. Cell dimensions of the French material are: length including processes 23-33 µm, breadth including processes 25-37 µm, thickness *ca* 7 µm.

The additional finds in Brenne confirm the supposed preference of this taxon for more eutrophic water bodies (Coesel & Joosten, 1996). It undoubtedly has a far more wider distribution in France than the four localities mentioned above. As in the Netherlands, eutrophication of many water bodies in France most probably has promoted its distribution and desmid research in such habitats is urgently needed.

▪ ***Staurastrum gladiosum*** Turner var. ***delicatulum*** W. & G.S. West
(Fig. 65)

Specimens belonging to this taxon were scarcely found in samples from Étang Alcoa (B7), a pool near Rosnay (B10) and Étang de l'Épineau (B15).

In front view the semicells are depressed reniform and furnished with spines, those at the angles being rather long, slender and sometimes curved. The sinus is acute and open. In apical view the semicells are triangular with concave sides and the angles somewhat tapering. Cell dimensions of the depicted specimen are (without spines): length 35 µm, breadth 35 µm; length of the spines is up to 8 µm.

S. gladiosum was described from New Jersey, U.S.A. (Turner, 1885). Var. *delicatulum* differs from the nominal variety by its more slender and slightly curved spines, which also have a different disposition on the cell wall (W. & G.S. West, 1900). The present material agrees very well with the description and figure of *S. gladiosum* var. *delicatulum* given by Coesel (1975). As already pointed out by this author, the taxon under discussion apparently prefers a more eutrophic environment than the related and very similar *S. teliferum* Ralfs (see, e.g., Kouwets, 1987). *S. gladiosum* var. *delicatulum* had not previously been mentioned from France; reports on the nominal variety are very scarse and somewhat doubtful since none of them is accompanied by a figure (Frémy, 1930; Pourriot *et al.*, 1969; Verger-Lagadec, 1963; Verger-Lagadec & Villeret 1963; Villeret *et al.* , 1972; Compère, 1980).

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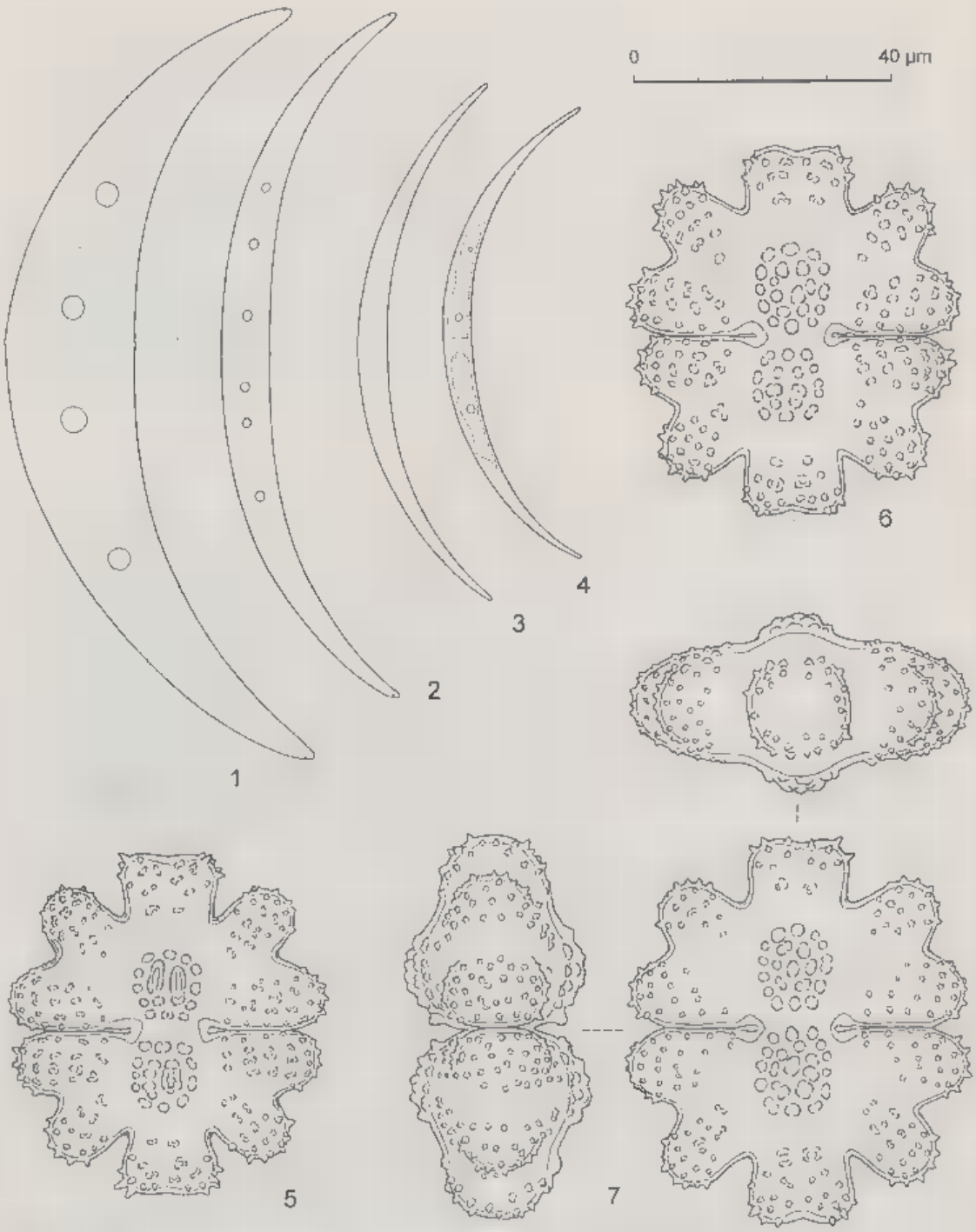
Table 1. Sampling localities situated in Sologne.

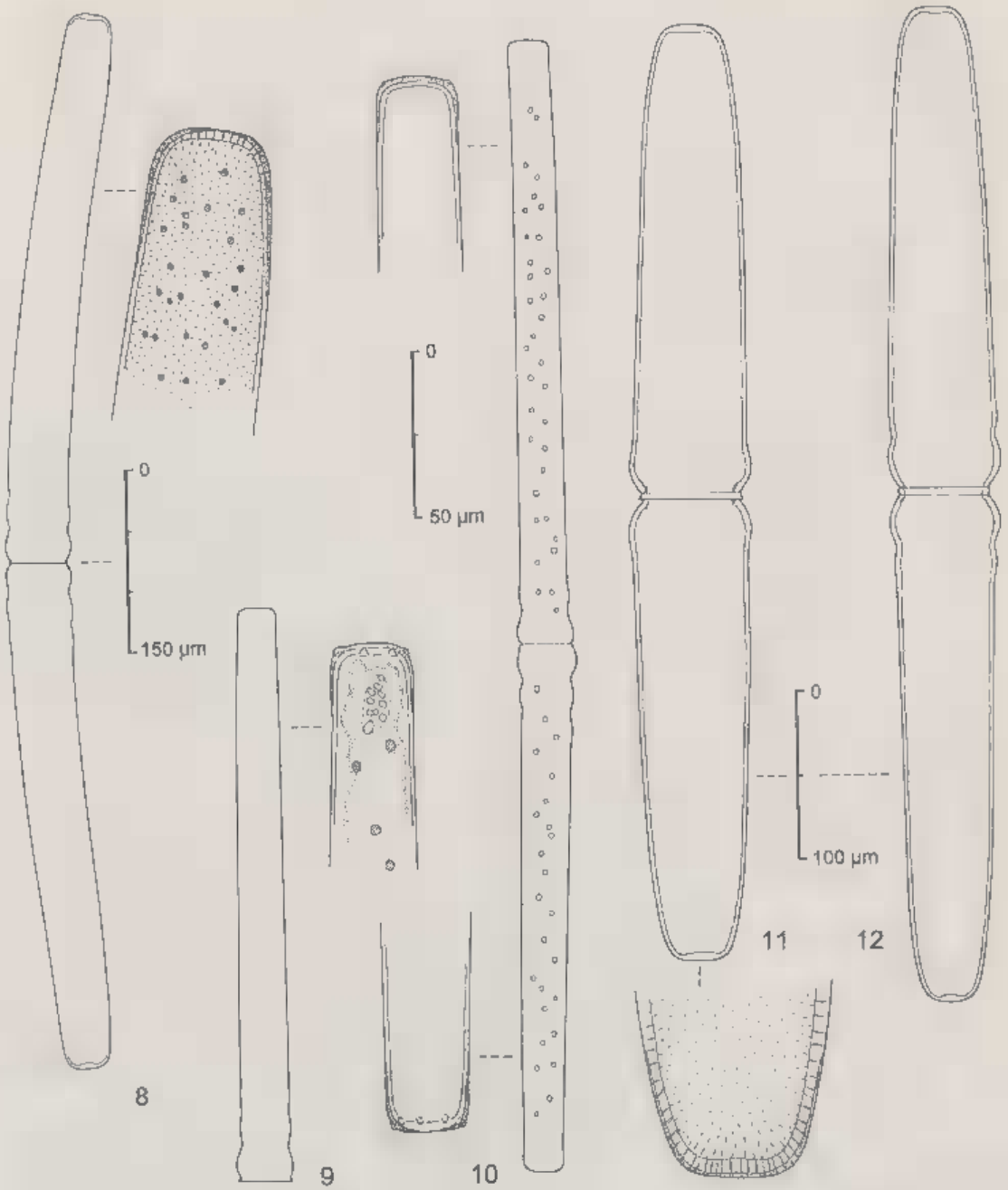
No.	Name of locality/situation	Date of sampling	Details concerning habitat and substrate
S1	Étang de Paris	22.VII.1983	Eutrophic; *Phragmites australis, Myriophyllum spicatum, Nymphaea alba*
S2	Étang de la Boitière	23.VII.1983	Eutrophic, loamy soil; *Nymphaea alba, Myriophyllum spicatum*
S3	Pool, 1.5 km east of Courmemin	23.VII.1983	Eutrophic; *Scirpus lacustris, Utricularia vulgaris*
S4	Étang de Pontbertas	23.VII.1983	Eutrophic; *Ceratophyllum demersum, Hydrocharus morsus-ranae*
S5	Étang du Briou	25.VII.1983	Eutrophic; *Phragmites australis, Iris pseudacorus, Nymphaea alba, Nuphar lutea, Trapa natans, Utricularia vulgaris*
S6	Étang de Bièvre	25.VII.1983	Eutrophic; *Najas marina*
S7	Lake, opposite Étang de Theillay	25.VII.1983	Eutrophic; *Riccia* sp.
S8	Étang des Levrys	19.VII.1990	Mesotrophic; *Hypericum elodes, Utricularia vulgaris, Nymphaea alba, Juncus bulbosus*

Table 2. Sampling localities situated in Brenne

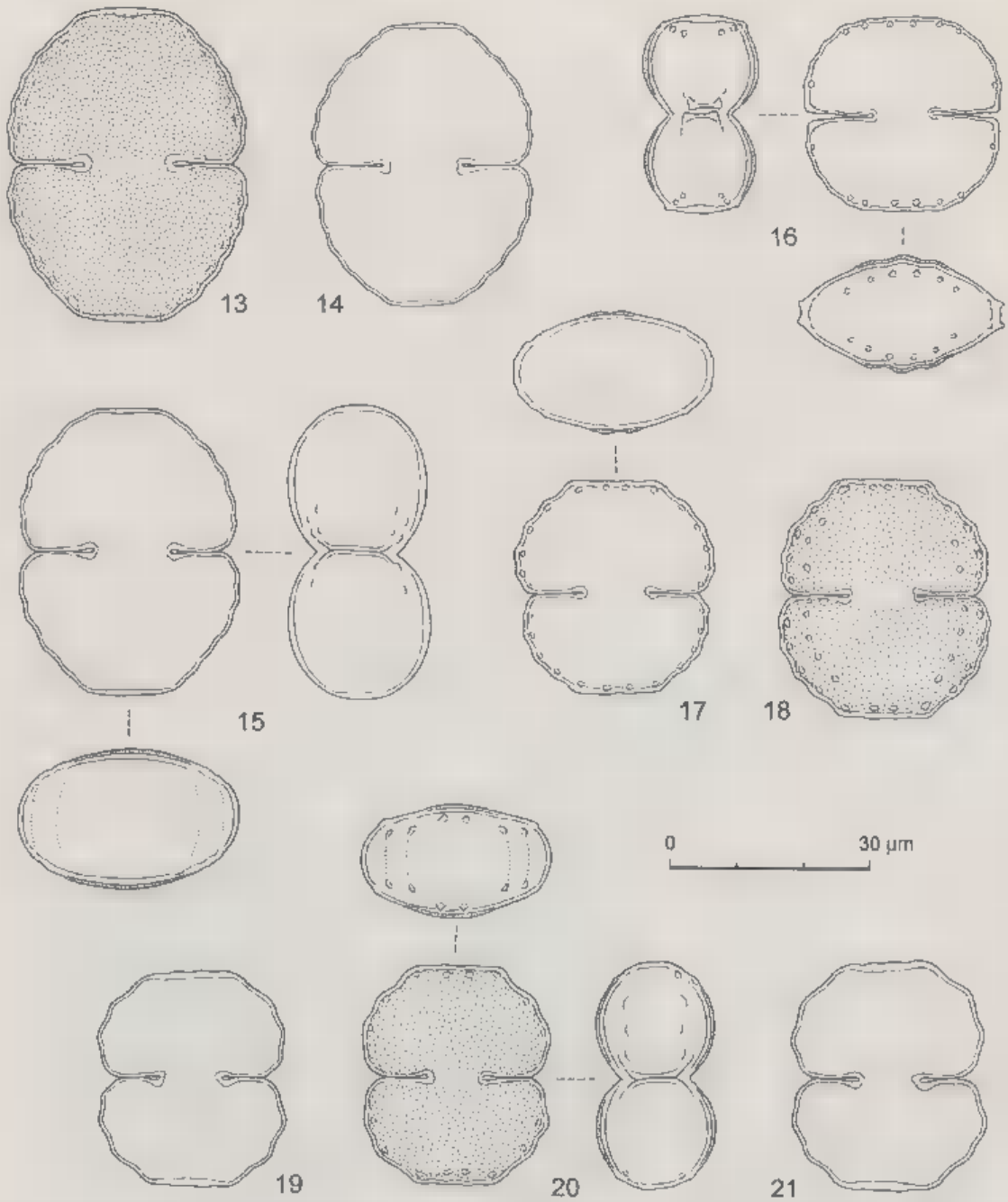
No.	Name of locality/situation	Date of sampling	Details concerning habitat and substrate
B1	Lake, 3 km west of Mézières-en-Brenne	28.VII.1983	Eutrophic; *Phragmites australis, Alisma plantago-aquatica, Typha latifolia, Myriophyllum spicatum, Potamogeton* spp.
B2	Étang des Vigneaux	29.VII.1983	Eutrophic; *Phragmites australis, Typha latifolia, Sparganium erectum, Utricularia vulgaris*
B3	Lake, 3.5 km south-east of Mézières-en-Brenne	29.VII.1983	Meso-eutrophic; *Phragmites australis, Carex* spp., *Hydrocotyle vulgaris, Scutellaria galericulata, Ceratophyllum demersum, Utricularia vulgaris*
B4	Lake, 2.5 km south-east of Mézières-en-Brenne	29.VII.1983	Eutrophic; *Phragmites australis, Utricularia vulgaris*
B5	Étang du Grand Mez	29.VII.1983	Eutrophic; *Phragmites australis, Nymphaea alba, Lythrum salicaria, Lysimachia vulgaris, Mentha aquatica, Hydrocotyle vulgaris, Carex* spp.
B6	Étang de Grandeffe	31.VII.1983	Eutrophic, loamy soil; *Phragmites australis, Typha latifolia, Nymphaea alba, Trapa natans, Myriophyllum spicatum, Utricularia vulgaris*
B7	Étang Alcoa	31.VII.1983	Eutrophic, loamy soil; *Nymphaea alba, Nuphar lutea, Potamogeton* spp., *Iris pseudacorus, Sparganium erectum, Carex* spp., *Myriophyllum spicatum, Utricularia vulgaris*
B8	Pool, 8.5 km north-east of Bélâbre	7.VIII.1993	Eutrophic, loamy soil; *Typha latifolia, Sparganium erectum, Iris pseudacorus, Potamogeton natans, Myriophyllum spicatum*
B9	Étang de la Cure	9.VIII.1993	Eutrophic, loamy soil; *Phragmites australis, Iris pseudacorus, Solanum dulcamara, Nymphaea alba, Nuphar lutea, Myriophyllum spicatum*
B10	Pool, 1.5 km north-west of Rosnay	9.VIII.1993	Eutrophic; *Phragmites australis, Nuphar lutea, Myriophyllum spicatum, Utricularia vulgaris, Najas marina*
B11	Small lake, 4.5 km north-west of Rosnay	9.VIII.1993	Eutrophic; *Phragmites australis, Lysimachia vulgaris, Lythrum salicaria, Ranunculus flammula*
B12	Pool, 4.5 km north-west of Rosnay	9.VIII.1993	Eutrophic; *Utricularia vulgaris*
B13	Étang Montiacre	9.VIII.1993	Eutrophic; *Myriophyllum spicatum, Najas marina, Potamogeton crispus*
B14	Étang de l'Hardouïne	11.VIII.1993	Eutrophic; *Phragmites australis, Myriophyllum spicatum, Utricularia vulgaris, Potamogeton* spp.
B15	Étang de l'Épineau	11.VIII.1993	Eutrophic; *Phragmites australis, Nymphaea alba, Potamogeton perfoliatus, Ceratophyllum demersum, Najas major, Myriophyllum spicatum, Utricularia vulgaris*



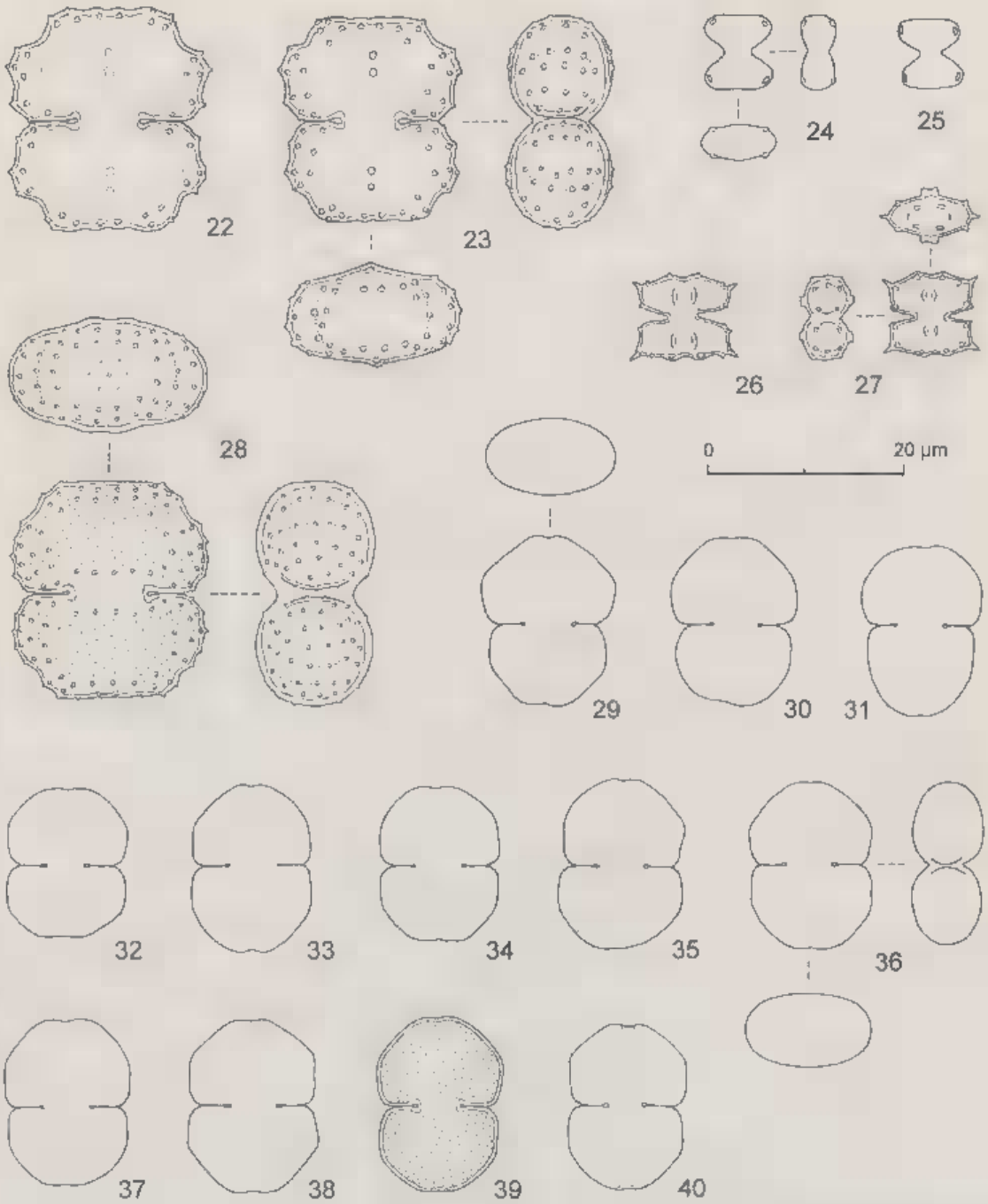
Figs 1-7. Fig. 1. *Closterium parvulum* var. *cornutum*. Fig. 2. *C. parvulum* var. *angustum*. Figs 3-4. *C. exiguum*. Figs 5-7. *Euastrum germanicum*.



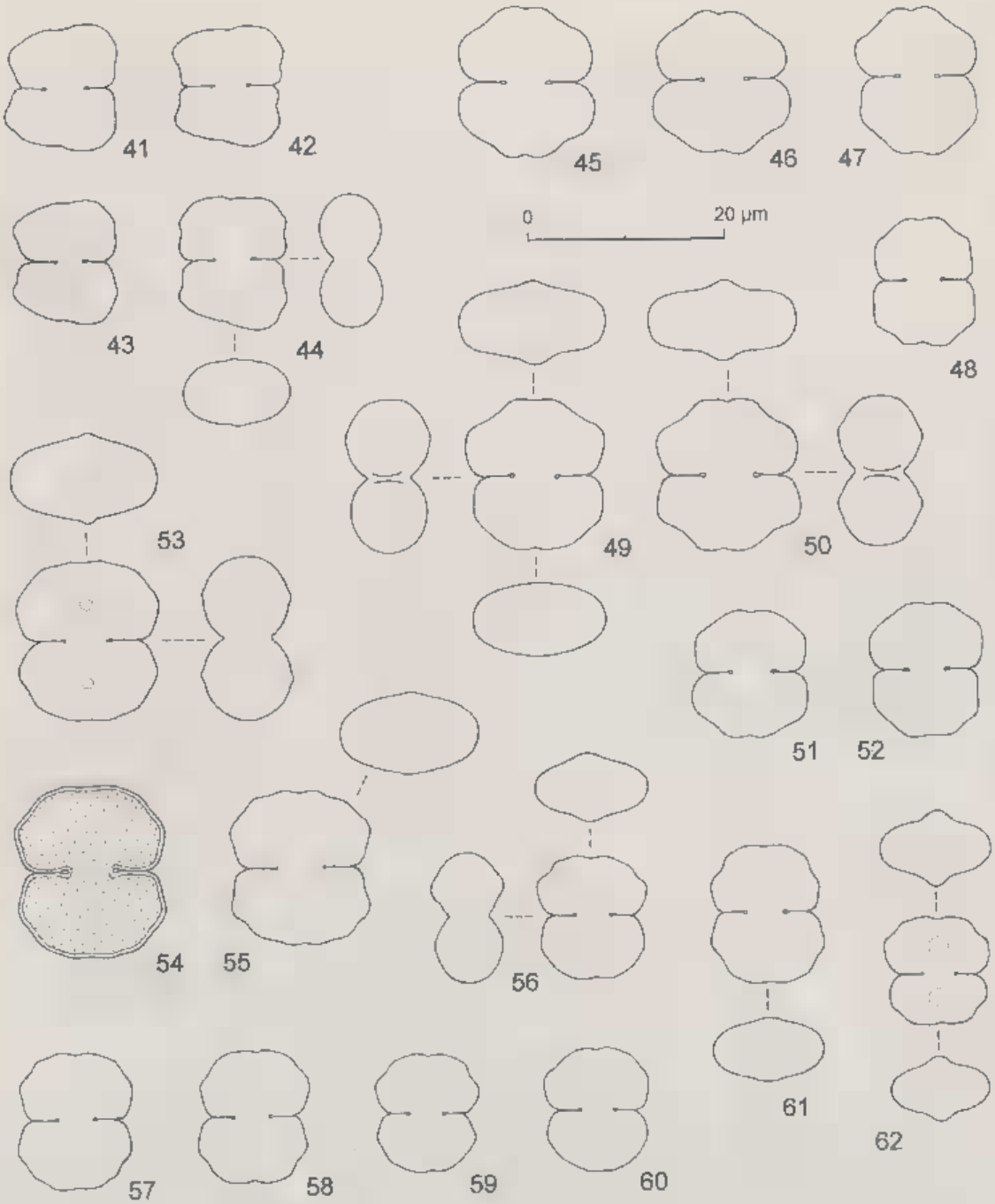
Figs 8-12. Fig. 8. *Pleurotaenium maximum*. Figs 9-10. *P. excelsum* var. *borgei*. Figs 11-12. *P. trabecula* var. *robustum*.



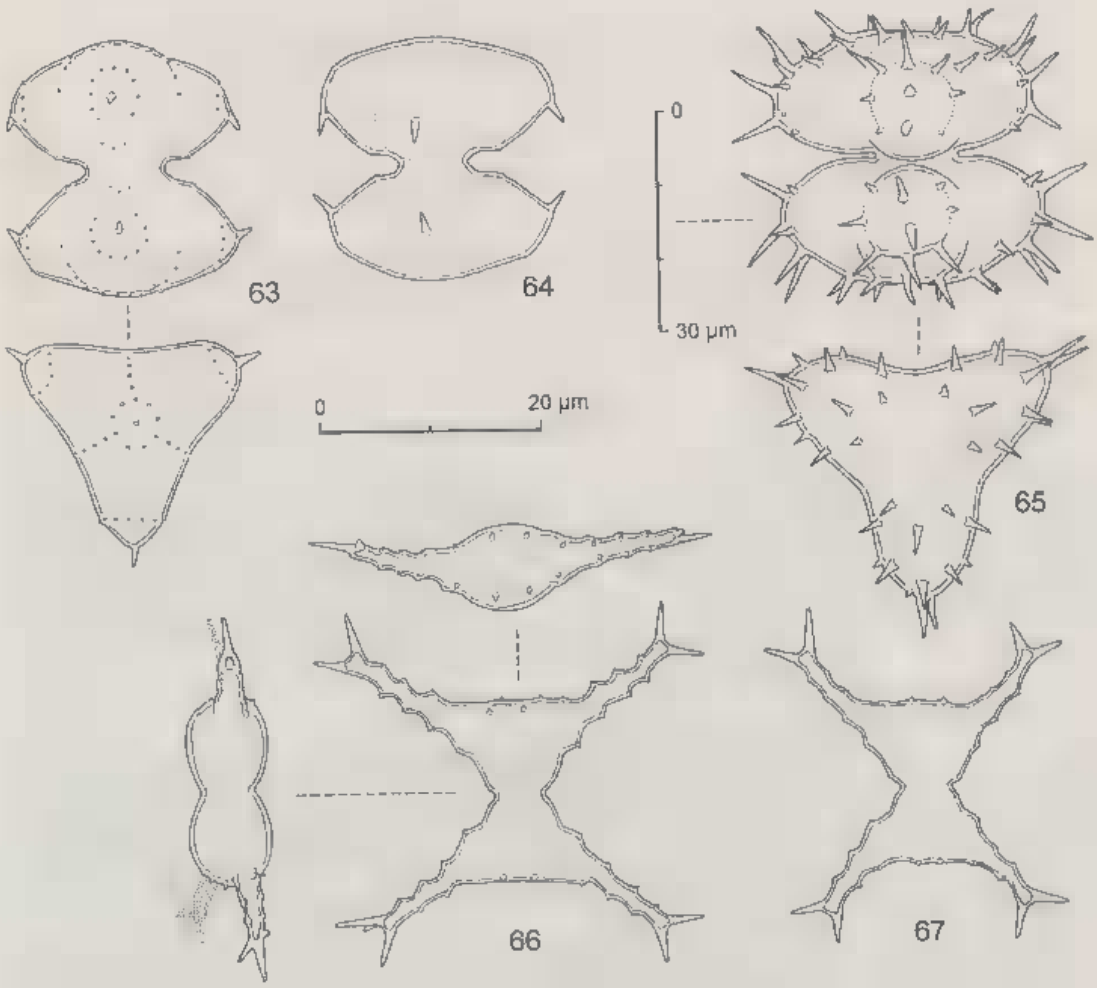
Figs 13-21. Figs 13-15. *Cosmarium jaoi*. Fig. 16. *C. haynaldii*. Figs 17-18. *C. limnophilum*. Figs 19-21. *C. sexnotatum* var. *bipunctatum*.



Figs 22-40. Figs 22-23. *Cosmarium berryense*. Figs 24-25. *C. lutetianum*. Figs 26-27. *C. dilatatum*. Fig. 28. *C.* sp. Figs 29-40. *C. angulosum* var. *concinnum*.



Figs 41-62. Figs 41-44. *Cosmarium asymmetricum*. Figs 45-52. *C. pseudowembarense*. Figs 53-55. *C. boitierense* var. *boitierense*. Figs 56-62. *C. boitierense* var. *inambitiosum*.



Figs 63-67. Figs 63-64. *Staurodesmus reginae*. Fig. 65. *Staurastrum gladiosum* var. *delicatulum*. Figs 66-67. *S. bloklandiae*.